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SE-38: SOVIET BLOC CAPABILITIES AND PROBABLE COURSES OF ACTION IN ELECTROMAGNETIC WARFARE

Appendix A: Evaluation of Economic Factors

I. INTRODUCTION

1. From an economic point of view, the telecommunications resources of the Bloc consist of two principal components: (a) the radio and wire communication systems in being, including operating equipment, technical personnel, essential services and supplies, notably electric power; and (b) the communications equipment industry, including its plant facilities, manpower, and supporting sources of essential materials and power. The present physical capabilities of the Bloc for waging electromagnetic warfare are determined almost exclusively by the first component, particularly by the quantity, technical characteristics, and geographic distribution of the operating equipment. Bloc capabilities, moreover, could be increased by diverting to electromagnetic warfare communications resources now used for a variety of purposes. The communications industry is important primarily as a determinant of the Bloc's ability to improve and expand its electromagnetic warfare capabilities over the longer run.

II. PRESENT BLOC RESOURCES IN TELECOMMUNICATIONS

A. Facilities

2. The Bloc operates extensive telecommunications facilities to support its domestic, intra-Bloc, and international activities over some 12 million square miles. Wire and radio facilities are readily available at practically all important military headquarters.

3. The principal wire and radio facilities of the Bloc are shown on the accompanying maps. Figure 1 shows the principal wire lines and more than 2,300 fixed radio station locations; Figure 2 shows the location of over 1,000 aeronautical radio communication stations (212 with radio navigation aid facilities), 333 maritime radio communication stations, and 103 maritime radio navigation aid facilities. The stations spotted on Figure 2 all operate or serve mobile radio units (aircraft, vessels, and vehicles).

4. All transmitters capable of emitting radio signals are potential jammers. It is estimated that the Bloc's wire and radio communication systems as a whole comprise some 9,600 significant transmitters. A complete breakdown of this total by type of service is not available, but Table 1 summarizes certain aggregate statistics on the Bloc's telecommunications system.

5. The basic telephone and telegraph system of each Bloc country, employing both wire and radio, is integrated nationally and services primarily the state authority. Each of these systems in turn shows some integration into one massive Bloc-wide system with Moscow as the focal point. The basic system serves the general political, social, commercial, and military needs of the Bloc. In addition, there are functional systems, in the main connected with the basic system, which meet the need for security, police, industrial, aeronautical, maritime, meteorological, and military operations.

6. In the basic system alone there are believed to be over 30 main radio and wire centers in the USSR, 14 in Communist China, and some 36 in the Satellites. For the handling of international point-to-point radio and wire communications, there are believed to be 12 gateway cities* in the USSR, 28 in Communist China, and 30 in the Satellites. Table 2 is a tabulation of reported Bloc international telecommunications circuits.

7. Large areas east of the Urals and north of the Trans-Siberian Railroad, as well as wide areas of Communist China, remain uncovered

* Gateway cities are cities with through international radio and/or wire channels.

or thinly covered by wire lines and depend largely or wholly on radio for rapid communications. The present long-range civil radio network of the USSR handles 15 percent of the traffic volume between the major cities along the Trans-Siberian Railroad and 80 percent of traffic north of the railroad. This system is equipped with numerous directional, high-gain antenna arrays which decrease susceptibility to jamming. Aeronautical and maritime networks are more vulnerable to jamming because of lower power and less directional antennas.

8. Bloc dependence on radio is not limited to the areas lacking wire lines; mobile units are almost completely dependent on radio for rapid communications and for certain navigational services. Radio also is used heavily between many points within the Bloc which are connected by wire.

9. The USSR employs radio more intensively and extensively than any other country in the world. Communist China's use of radio is relatively inconsequential as compared with that of the USSR, but low-powered radio stations of 1 KW or less are located at many wire junctions and supplement wire facilities. On the other hand, the European Bloc (except for Albania) is well served by wire facilities, and does not depend on radio so extensively.

10. The Bloc mass aural radiobroadcasting systems make heavy demands on radio facilities. Domestic services use at least 400 radio transmitters, employing a wide range of powers and operating in the low, medium, and high frequency bands below 30 megacycles (see Table 3). Some of these transmitters probably are employed at times in the jamming operation. The international service is itself considerable (see Table 4), though the number of transmitters employed for this service alone is not known.

11. Wire lines play an increasingly significant role in Bloc mass aural domestic radiobroadcasting service. They are used to relay broadcasting programs between some cities. More important, however, is their use for the distribution of broadcasting programs to loudspeakers. Such wire lines are generally independent and separate from those used for telephony and telegraphy. Radiobroadcasting stations are directly connected by wire with loudspeakers in their vicinity. The wire link is also used to transmit programs to distant wire-diffusion exchanges to which loudspeakers are connected. More remote areas are served by wire-diffusion exchanges which pick up programs by radio, amplify them, and distribute them to wired loudspeakers. Table 5 gives estimates of the number and character of Bloc reception facilities for 1952 and 1953.

12. A possibly significant addition to the Bloc communications system is represented by the development during the last 3 years of microwave radio relay equipment of predominantly 8-channel type. This equipment permits highly directional transmission at extremely high frequencies, with relay stations required at line-of-sight distances. It provides much greater security from hostile interference and enemy interception.

B. Production of Equipment

13. The Bloc electronics industry comprises an estimated 120 to 150 plants in the USSR and over 135 plants in East Germany, Czechoslovakia, and Hungary. Approximately 85 percent of the plants are engaged in the assembly of end products and major subassemblies, and the remainder in production of tubes and other component parts.

14. It is estimated that the total production of the Bloc electronics industry in 1952 was $750 million at US prices. Approximately three-fourths of the electronics equipment produced in the Bloc is allocated to military needs, and the remainder to civilian needs.

15. The Bloc produces nearly all its own transmitter equipment. Most of the production is from 12 known plants in the USSR, but East German and Hungarian production is also significant. East German

production for the period 1950-1952 was approximately 600 transmitters with a total rated power exceeding 2,500 KW. Of particular importance because of their high power were 9 units ranging from 100 to 500 KW and 17 units ranging from 3 to 50 KW. Hungarian factories are reported to have produced 700 transmitters (5 of which ranged between 120 and 135 KW)for the USSR during 1949-1951.

16. It is estimated that the Bloc produced 64 million electron tubes of all types in 1952, nearly 3 million of which were transmitting and other special tubes (see Table 6). There has been no indication since 1950 that the Bloc transmitter program has been hampered by shortages of tube manufacturing facilities. In fact, East Germany has a capacity to produce transmitting tubes which is currently not being fully utilized.

17. It is estimated that the Bloc has produced about 2,700 microwave equipment units (each unit comprising a transmitter and a receiver) during the period 1949-1952. Approximately 1,750 units were produced in East Germany (see Table 7) and the remainder are believed to have been produced in the USSR. There is no evidence of microwave equipment production in the Satellites other than East Germany.

18. Production of all types of civilian radio receivers in the Bloc increased from slightly more than 1 million sets in 1948 to about

1.6 million sets in 1951.* During the same period the output of short-wave receivers decreased from 825,000 to roughly 650,000 sets. This decrease does not indicate any special difficulty encountered by the Bloc in producing short-wave sets, but probably reflects an effort to reduce the availability of those types of radio sets capable of receiving Western broadcasts.

19. Bloc production of telecommunications wire line equipment is adequate to maintain existing wire communication systems and to expand them in accordance with published plans. However, despite the rapid expansion of wire and cable plants since 1948, the Bloc is dependent on imports for 20 percent of its wire and cable. Production of wire could be greatly increased if raw copper were diverted from other uses. The Bloc requires an estimated 84,000 metric tons of copper for its current production of both communications and industrial wire and cable. This requirement represents over -- percent of the Bloc's production of copper, estimated at 323,600 metric tons. Bloc production is supplemented by an estimated 80,000 metric tons of imported copper in the form of crude metal and wire and cable.

* Of the 1.6 million receivers produced in 1951, 450,000 were relatively insensitive crystal receivers.

20. Soviet dependence on Western imports of critical electric and electronic test equipment is rapidly decreasing. In 1951 the estimated total of imports was $14 million, or 2 percent of Bloc production of electronic equipment. These imports included large shipments of transmitter equipment and tubes for some components of which the Bloc is still partly dependent on foreign sources.

21. Present trade controls have kept the Bloc's imports of electronic equipment below the 1951 level. However, significant quantities of materials, and certain machines, required in the manufacture of tubes and components are still being imported. Many of the materials in this trade, such as refractory metals and diamond dies, are difficult to interdict effectively because of the small tonnages involved.

C. Electric Power Supply

22. Only a small percentage of Bloc total electric energy production is consumed by telecommunications facilities. There are no indications of a shortage of electric power having affected the operation of Bloc telecommunications. Electrical power services are available from central stations to most of the Bloc area west of the Urals and to certain limited Bloc Asiatic areas. In regions without central station

supply, power must be obtained from more localized sources such as generators or batteries. Consequently, in large areas of Siberia and China it might be difficult to insure reliable rapid communications services under conditions of sudden heavy demand.

D. Manpower Resources

23. Through stepped-up training programs, the USSR by 1950 had largely overcome the more critical postwar shortages of skilled workers. It is estimated that 4,600 electrical engineers are now being graduated annually from college-level institutions, and 10,000 technicians from advanced communications schools.

24. The Bloc would not encounter a serious manpower shortage in increasing its electromagnetic warfare activities. The total number of workers in the Bloc electronics and telecommunications manufacturing industries is estimated as 292,000 for 1951, and 372,000 by the end of 1952. Non-military personnel operating the communications facilities of the USSR are estimated at 600,000. The military services and the radio amateur group are additional sources of trained manpower.

III. BLOC CAPABILITIES FOR EXPANDED ELECTROMAGNETIC WARFARE

A. Diversion of Telecommunications Facilities from Normal Service

25. It is believed that the Bloc could increase its current jamming effort by use of reserve transmitters, by more efficient use of facilities and services, and by diverting traffic to alternative media. While it is estimated that roughly 1,000 to 2,000 additional transmitters could be employed for jamming purposed without significantly impairing Bloc telecommunications, the extent to which transmitters could be so diverted depends on the number of hours of jamming operation, the time of day, the target area, and the location and technical characteristics of the transmitters available.

26. It is not possible to determine the precise degree of diversion of transmitters which each of the measures discussed below might permit. The estimated ability of the Bloc to use these measures is based in part on analogical comparisons with operational procedures standards in other countries. Also, some of these measures may already have been exploited to some extent in support of the current Bloc jamming operation.

a. Use of Reserve Transmitters

Most countries provide reserve transmitters for their main radio stations in order to insure continuity of service; each of the Bloc stations probably has at least two transmitters. It is also likely that the Bloc has a considerable number of transmitters in strategic reserve. In addition, there are probably a number of transmitters actually in service which are potentially an additional reserve. Such transmitters would include units engaged in dummy traffic to conceal operational surges in traffic, in other types of deception traffic, and in training radio operators on live circuits.

b. Rationalization of Transmitter Facilities

It is estimated that there are hundreds of lightly loaded services which do not require the use of their transmitters on a 24-hour stand-by basis and thus could provide many hours of jamming service. Release of such transmitters might be obtained by reducing the number of transmitters at a single location operating in different services. Additional use of transmitters also could be gained by increasing within limits the speed of telegraphic transmission, and/or by increasing the channel capacities served by a single transmitter.

c. Transmitters Released by Acceptance of Delayed Service

The output of transmitter facilities would be greatly increased by flattening out the 24-hour traffic load curve, and accepting some delays in less essential service. For example, a substantial number of transmitters could be released by the reduction of the number of points involved in direct intercommunication.

d. Reduction of Non-essential Services and Use of Alternative Media

Diversion of non-official private messages from point-to-point rapid communications services to the mails would release some radio transmitters and wire lines for higher-priority messages. In addition, the Bloc probably could divert a number of transmitters now engaged in mass aural radiobroadcasting. The reduction of aural radiobroadcasting would be offset to some extent by continued expansion of the extensive wire-diffusion network developed for carrying programs to loudspeakers. Present dependence on radio for rebroadcasting to wire-diffusion centers is decreasing and could be overcome by further extension of wire and by forwarding program transcriptions by physical means.

c. Rescheduling of Essential Radio Services

The radio communication services which the Bloc would continue to maintain under conditions of extended electromagnetic warfare could be rescheduled as to time, area, frequency band, and/or transmitter assignment in such a way as to improve the availability and freedom of action of facilities for jamming operations.

B. Diversion of Resources to Production of Jamming Equipment

27. It is believed that the Bloc electronics industry could provide for substantial increases in the production of transmitters for jamming by cutting back non-essential electronics production. For example, the cost of producing 1,000 standard 10-KW communications voice transmitters, which are entirely adequate for jamming operation, is estimated at approximately $22 million at US prices. This cost represents about 3 percent of the total value of output of the Bloc electronics industry for 1952, or about 12 percent of the 1952 value of Bloc non-military electronics output. The production of the first additional 1,000 transmitters in a year could probably be undertaken without serious displacement in the industry; production of jammers at higher rates would entail serious diversion of resources and production.

28. The Bloc would encounter at least a short-run difficulty in expanding significantly its output of communications cable and wire. Supplies of raw copper already are tightly allocated because of Bloc dependence on imports.

C. Diversion of Manpower

29. Most manpower requirements for expanded electromagnetic warfare could be met without difficulty by the reallocation of personnel in the existing communications services and electronic equipment industry.

D. Prospects over the Next 2 Years

30. The natural rate of growth of rapid communications facilities will yield a sizable increase in Bloc capabilities. Output of electron tubes, the best indicator of electronic capability, is expected to increase over 100 percent in value terms during the next 2 years (see Table 6). We estimate that microwave radio equipment production (see Table 7), wire-diffusion networks (see Table 5), and wire line and coaxial cable construction will expand rapidly. Some increases also are expected in existing wire line capacities. If electromagnetic warfare were to receive greater emphasis in production planning with particular attention to reducing dependence on radio communication below 30 megacycles, Bloc capabilities could be significantly increased.

Table 1

Tabulation of Estimates on the Soviet Bloc Telecommunications System
(Radio, Telegraph, Telephone, Telephoto)
1946, 1950-52

	Basic System	USSR	European Satellites	Communist China
1.	Kilometers of Wire a/ (Thousands)	3,000 (1952)	30,000 (1952)	600 (1952)
2.	Radio Transmitters (All Services)	7,150 (1952)	1,250 (1952)	1,210 (1952)
3.	Radio Transmitters (Broadcasting Services)	168 (1952)	105 (1952)	149 (1952)
4.	Radio Stations in Point-to-Point Service	1,490 (1951)	100 (1951) b/	328 (1950) b/
5.	Radio Stations 1 - 9 kw 2 - 30 mc	N.A.	63 (1951)	41 (1951)
6.	Radio Stations 10 - 19 kw 2 - 30 mc	N.A.	11 (1951)	8 (1951)
7.	Radio Stations 20 kw & Over 2 - 30 mc	425 (1951) c/	17 (1951)	2 (1951)
8.	Telephone Conversations, Total All Types (Millions)	132 (1951)	144 (1951)	6.5 (1951)
9.	Telegrams, Total All Types (Millions)	283.5 (1951)	51 (1951)	14.3 (1946)

a. Excluding wire lines devoted to wire diffusion.
b. Nine of the stations in the point-to-point service for the European Satellites and 277 for Communist China are below the 1-kilowatt (kw) minimum power covered for radios in lines 5, 6, and 7.
c. The USSR has submitted a total of 425 notifications to the International Telecommunications Union (ITU) for call letters for radio transmitters of 15-kw power or more in the frequency range from 6 to 13 megacycles (mc).

Table 2

Tabulation of Reported Soviet Bloc International Telecommunications Circuits a/
1 January 1952

Country	Number of Gateway Cities in Country Shown	Total Number of Countries Contacted	Total Number of Circuits		Number of Circuits with Other Bloc Countries		Number of Bloc Countries Contacted		
			Radio	Wire	Radio	Wire	Radio & Wire	Radio Only	Wire Only
USSR	12	30	35	32	11	9	4	3	1
Albania	2	5	3	4	2	1	0	2	1
East Austria	1	20	11	84	3	24	2	2	3
Bulgaria	1	16	13	26	6	5	1	1	5
China	28	30	73	42	15	14	2	2	1
Czechoslovakia	5	35	35	110	7	45	4	2	3
East Germany	3	16	11	7	7	2	0	7	1
Hungary	4	27	21	55	8	28	3	3	3
Poland	8	22	21	39	7	19	4	2	1
Rumania	6	17	19	30	8	19	4	1	2

a. Taken from EIC-R12, Appendix C. S.

S-E-C-R-E-T

Table 3

Estimated Number of Transmitters Used for Radiobroadcasting by the Soviet Bloc a/
(L = Low-Frequency; M = Medium-Frequency; H = High-Frequency)
15 January 1953

Country	No. of Cities Having Transmitters	Frequency Band	Power (in Kilowatts) .01-4	5-19	20-99	100-199	200-499	500 & Over	Subtotals	Total
USSR	87	L	8	13	13	9		1	44	167
		M	15	20	12	10			57	
		H	24	15	20	7			66	
Albania	6	L								10
		M	4		1				5	
		H	5						5	
East Austria	6	L								11
		M	6		1				7	
		H	4						4	
Bulgaria	3	L								6
		M		1	2	1			4	
		H			1	1			2	
China	60	L								149
		M	110	3	1				114	
		H	21	10	4				35	
Czecho-slovakia	14	L					1		1	24
		M	9	3	2	6	1		21	
		H			1	1			2	
East Germany	9	L			1				1	18
		M	4	3	5	1	1		14	
		H		3					3	
Hungary	5	L								10
		M	1	3		3			7	
		H		1		2			3	
Poland	11	L					1		1	16
		M	2	2	6				10	
		H		5					5	
Rumania	5	L				1			1	10
		M		2	3	1			6	
		H	2	1					3	
Totals			215	85	73	43	4	1		421

a. Taken from EIC-R12, Appendix E. R.

S-E-C-R-E-T

S-E-C-R-E-T

Table 4

Tabulation of Data on Soviet Bloc
International Aural Radiobroadcasting Services a/
1 January 1953

Country	No. of Cities Broadcasting in Country Shown	Average Number of Programs per Day	Average Daily Program (Hours)	No. of Different Languages Used	Frequency Band Used		
					Low	Medium	High
USSR	4	229	102	35	x	x	x
Albania	1	26	8	11		x	x
East Austria	1					x	x
Bulgaria	1	30	18	11	x	x	x
China	2	47	22	14		x	x
Czechoslovakia	1	55	29	14		x	x
East Germany	1			2		x	x
Hungary	1	46	27	12	x	x	x
Poland	1	78	45	13	x	x	x
Rumania	2	16	10	9		x	x
Totals	15	527	261				

a. Taken from EIC-R12, Appendix G. R.

S-E-C-R-E-T

Table 5

Estimate of the Number and Character of Soviet Bloc
Aural Radiobroadcasting Reception Facilities
1952-53

Units

	1952 a/			1953 b/		
	Wire-Diffusion Systems			Wire-Diffusion Systems		
Country	Exchanges	Loudspeakers	Radio Receivers	Exchanges	Loudspeakers	Radio Receivers
USSR	36,500	10,000,000	4,500,000	40,000	10,500,000	5,000,000
Albania	100	N.A.	19,000	100	N.A.	20,000
Bulgaria	891	114,595	250,000	1,100	143,000	260,000
China	(Thousands)	N.A.	1,000,000	(Thousands)	N.A.	1,000,000
Czechoslovakia	N.A.	500,000	2,600,000	N.A.	500,000	2,730,000
East Austria	N.A.	N.A. c/	900,000	N.A.	N.A.	950,000
East Germany	N.A.	N.A. c/	4,000,000	N.A.	N.A.	4,100,000
Hungary	N.A.	160,000	627,000	N.A.	190,000	635,000
Poland	7,450	725,000	1,250,000	8,000	785,000	1,330,000
Rumania	200	100,000	300,000	300	150,000	310,000
Total Bloc			15,446,000			16,335,000

a. The 1952 estimates are from EIC-R12, Appendix J. S.
b. The 1953 estimates are projected from ORR estimates for previous years.
c. Fragmentary reports indicate that wire-diffusion systems are also under development in these countries.

Table 6

Total Estimated Output of Electron Tubes
in the Soviet Bloc a/
(Rate of Output at End of Year)
1951-52, 1955

	All Types		Transmitting and Special Tubes
Year	Number of Tubes (Millions)	Dollar Value (Million $)	Number (Millions)
1951	50	62	2.4
1952	64	82	2.9
1955	115	170	5.5

a. Output and capacity frequently differ because of manufacturing variables. These figures are based on a forthcoming supplement to CIA/RR 7, The Electron Tube Industry in the Soviet Bloc, 29 August 1952. S, US OFFICIALS ONLY. They were adopted on the basis of the analysis of plant output rather than analysis of plant capacity.

Table 7

Estimated Production of Microwave Radio Equipment
in East Germany
1949-55

	Units
Year	Amount a/
1949-50	500
1951	500
1952	750
1953	1,000
1954	1,500
1955	1,800

a. Production is expressed in equipment units. Each unit includes a transmitter and receiver.

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Appendix B: Evaluation of Technical Factors

I. BLOC ELECTROMAGNETIC WARFARE ACTIVITIES TO DATE

A. Extent and Techniques of Broadcast Jamming

1. Short wave jamming was first directed against Russian-language VOA and BBC programs on 3 February 1948, and continued on a moderate scale during the next year. On 24 April 1949 jamming action was greatly stepped up.* Frequency ranges were extended to include medium and long wave broadcasts, the number of jammers employed was increased, and jamming was extended geographically through the coverage of Satellite and Finnish languages. Sources of additional programs jammed included Radio Free Europe, Radio Free Asia, and Vatican City. In 1953 Hebrew and Turkish language programs have also been jammed.

2. In general, the jamming has been directed against programs intended for reception within the Bloc area. However, on 30 January 1953 a Danish long wave broadcasting station was jammed while carrying a domestic program in Danish which the Soviet Minister had stated was insulting.

*OSI-1-50 "Historical Developments in the Jamming of the VOA by the USSR", CIA, 20 January 1950

3. Broadcast signals ranging in frequency from 230 kc. to 21.7 mc. have been reported jammed. The jamming signal is usually a relatively narrow band so that it will not be likely to affect neighboring channels. The jammers in use at the present time have very wide variations in power output, depending upon the frequency of operation and the type of coverage intended. Output ranges from a possible low of 1 kw. to highs of 50 to 200 kw. on high frequencies and to 500 kw. on medium or low frequencies.

4. We estimate that the number of transmitters employed for jamming is approximately 900. The majority of the jamming stations are in the European USSR; a relatively small number are in the Satellites. The USSR has at various times diverted transmitters from domestic program service to jamming, and has jammed even when it covered domestic programs. Cooperation between the USSR and Satellites, and between Satellites, is indicated by use of jammers in one Bloc country to cover programs directed to another.

5. Control of 30% to 40% of the jammers is immediate and flexible so that they can follow changes in schedule or frequency, often within a minute or less. This reveals existence of an efficient monitor control network. Control of the remaining jammers is apparently less direct since they do not quickly respond to changes -- sometimes not for several days. The organization

responsible for the control of the jamming of VOA has not been positively determined. However, responsibility for basic policy probably is assigned to the MGB (Ministry of State Security).

6. In addition to preventing Western broadcasts from reaching Soviet and Satellite peoples, the Bloc's jamming effort has provided training in jamming techniques and system coordination.

B. Effectiveness of Broadcast Jamming

25X1C

7. According to an analysis of 2258 monitoring reports [redacted] propaganda program transmissions directed to the European Satellites ~~are penetrating the target areas and can be heard with~~ achieve good ~~or better~~ reception on at least one channel for over half the program periods. Programs to the Far East can be heard with good ~~or better~~ reception on at least one high frequency channel for nearly all program periods, but medium frequency is received well only about half the time. Some of this difficulty may be due to interference other than deliberate jamming. On the other hand, these programs have only sporadic penetration within Western USSR, especially in the large urban areas. Technical expedients, such as greatly increasing the number of frequencies used simultaneously to carry the same programs, have apparently not been very successful in the European USSR.

25X1C

8. Reports from listeners within the Bloc are limited to non-technical information on effectiveness. Some reports from the Satellites provide technical information on transmitters which could be used for jamming, on development activities, and on tubes and transmitters; these reports shed some light on capabilities. Most of the technical details concerning the present jamming effort have been obtained from careful and repeated observations at receiving stations in friendly territory. In Particular, excellent results have come from a restricted but continuous effort by experienced observers

25X1C

[redacted]

C. Jamming of Signals Other Than Broadcast

9. In the past three years there have been more than 40 cases of interference with US communication circuits which might have been instances of Soviet jamming. A review of these cases indicates that it it exceedingly difficult to distinguish among: (a) unintentional interference, (b) radio jamming against VOA and BBC which spills over into U.S. communications circuits, and (c) deliberate radio jamming of communications circuits. Incidents of this last type have generally involved air-ground frequencies.

10. The various incidents reported thus far do not appear to indicate ~~an over-all Soviet plan for interference~~ a systematic jamming effort against US communications circuits. All reported and investigated cases of interference with navigation aids seem to have been unintentional interference from transmitters operating on assigned frequencies. After due allowance for VOA radio jamming and ~~the~~ unintentional interference, however, there still remain a few instances which cannot be readily explained except as deliberate jamming of communications circuits. For example, successful jamming of long range shore-to-ship communications by a jammer apparently located in the vicinity of Leipzig occurred during

25X1A [redacted] The shipborne receiver was within the effective range of the jammer, a condition which could exist a large portion of the time in the course of naval operations in general war with the Bloc.

11. The lack of conclusive evidence of intentional jamming of military circuits does not indicate a lack of capabilities. The techniques used for broadcast jamming could be used against long range military circuits. It should be noted that for jamming purposes broadcasts to the Bloc offer one great advantage that commercial and military circuits often do not, namely, relatively fixed schedules and channels and proximity of the receiving end. Nevertheless, the Bloc is capable of seriously disrupting long range trans-Atlantic and trans-Pacific circuits. It is believed, however,

that it is not likely to employ coordinated measures against military communications circuits unless a general war occurs.*

II. PRESENT BLOC CAPABILITIES FOR ELECTROMAGNETIC WARFARE

A. Available Jamming System Components

12. Large scale jamming operations require: (a) transmitters and associated antennas, (b) monitor-control networks, and (c) competent personnel. The Bloc today possesses these necessary elements of a large-scale jamming system.

13. Transmitters and associated antennas. In order to evaluate properly the Bloc jamming transmitter capability, it must be recognized that any radio transmitter can be used to jam certain targets. However, transmitters to be utilized for jamming long range circuits must be capable of operating in the frequency range over which the jamming is to take place. They should be situated geographically to take advantage of varying radio propagation conditions, they should have a reasonably high power output, and they should be designed to make fairly rapid frequency changes. Large numbers of directional

* The technical problem of jamming long range communications has been considered with respect to U. S. transoceanic circuits. It is considered that they are illustrative of the problem of long range communications of other western countries. Time has not permitted an investigation of the special technical problems of jamming of Arctic communications. Consideration has been given to the problems of jamming long range navigation systems used by other NATO countries as well as those used by the U.S.

antennas capable of beaming transmissions to the target areas should be associated with the transmitting stations.

14. Since the Bloc has shown ability and willingness to divert transmitters from other services, the entire Bloc transmitter plant should be considered as a potential source of jamming equipment. It is estimated that there are at least 9600 significant radio transmitters in the Bloc. Available information on broadcast transmitters operating in the Bloc indicates a total of 421, of which 167 are in the USSR. In the Moscow area there are approximately 38 broadcast transmitters, 25 of which have been active internationally. Since the Bloc began intensive jamming operations, there has been an increasing number of jammers capable of rapid frequency changes. Some jammers make changes of 10-15 kc. in as little as a few seconds, while others require up to a minute. Many radio transmitters now in other services probably could be diverted to a jamming operation with no effect on essential traffic handling capability; additional numbers of transmitters could be diverted through some sacrifice of least essential services.

15. Interception of experimental Loran type signals operating on 150 kc. shows that the Bloc has high powered transmitters on LF. Bloc transmissions have been observed on frequencies as low as 20.1 kc/s. International radio frequency registration shows some 26 assignments below 60 kc/s. The indicated power is generally comparatively low,

although there are two assignments of 120 kw. and one of 100 kw. It is apparent that the special techniques of LF and VLF are well known to the Bloc.

16. The Soviets have been active in the field of antenna design for many years. Observation of some of the main communication centers in the Bloc reveals vast antenna farms of directional antennas permitting efficient transmission in many directions. The Bloc probably has satisfactory antenna arrays associated with many of its transmitters enabling direction of jamming signals toward their target areas.

17. Monitor and Control Networks. An effective monitor/control network must be an integrated part of the jamming system to achieve maximum efficiency in attacks and to nullify evasive action. This network searches out target transmissions, assigns missions to the jammers, and checks results. Study of jammer operations indicates existence of a highly efficient Bloc monitor control net which probably utilizes wire line communications. One center of such control is believed to be located at Beelitz in East Germany. It is likely that the Bloc could increase these facilities as needed.

18. Competent Personnel. A cadre of personnel skilled in electromagnetic warfare obviously has been developed since concerted jamming commenced in 1949. There have never been any indications

of general shortages of qualified communications personnel in the USSR. The Soviets are sufficiently knowledgeable and skilled in the field of radio wave propagation to deal with the jamming problem. They have had access to information on most of the work done in the field in the U.S. and elsewhere, and have conducted an extensive research program of their own.

B. Capability for Disruption of Long-range Telecommunications Circuits and Navigation Aids

19. The attached map shows some of our important high frequency transoceanic circuits, and indicates how close the termini of many of them come to Bloc territory. The signals of several circuits traverse Soviet territory in following a great-circle path. A

25X1B

[redacted]

25X1B

[redacted] Consideration was given to summer and winter conditions of propagation. Results showed that conditions are favorable to jamming of all six circuits during a large portion of the time.

20. The receiver at the U.S. end of the circuit is particularly vulnerable because of the proximity of Bloc territory to the transmitter at the far end, making wave propagation conditions very similar over the paths of both the desired signal and the jamming

signal. With jammers strategically located within Bloc territory, it is concluded that a jamming signal can be established at this end at almost any time. In most cases, the direction of arrival of the jamming signal and the desired signal would be so nearly the same that the use of directional receiving antennas would be little or no help in discriminating between them.

21. The receiver at the end of circuits nearest Bloc territory is in general about as vulnerable as the one at the U.S. end during the summer months. During the winter months freedom from jamming could exist for a period of about four hours or less by a careful selection of operating frequencies. In some cases, directional receiving antennas would be of considerable assistance, but not where the communications path traverses Bloc territory.

25X1B

[redacted]

23. These considerations of jamming point-to-point communications can be applied to mobile communications (shore-to-ship and ground-to-air),

noting that vulnerability may be higher because the mobile station usually employs relatively low power and does not employ directional antennas. Moreover, there are generally no alternative means of communication for such purposes.

24. Communication with submerged submarines largely depends on very-low frequencies (VLF), chiefly because of their greater underwater penetration. Jamming of these very-low frequencies would seriously impair long-range communications with U.S. submarines. Coverage by existing VLF stations is not presently adequate for world-wide reception even on the surface and in the absence of jamming. As present day receiving antennas are little better than omnidirectional, these frequencies are very vulnerable to jamming; this situation probably will not be improved within the next two years.

25. Recent Soviet experiments on their LF Loran chain operating on 150 kc. showed substantial capability for jamming in the field of low frequency high power transmission. Practical experience gained by the Soviets in experimenting with their own long-range navigation aid system would be of value to them should they attempt to jam western systems of a similar nature. Propagation characteristics would grant our N.W. Atlantic Loran chains a high degree of immunity during daylight hours, but no such immunity could be expected when

the path of the jamming transmission lies wholly or for the major part in darkness. However, alternate navigation aids operating in the frequency band under 30.0 mc. -- the Decca navigator, low/medium frequency beacons, and Consol -- are available in the European theater. All three systems operate on low frequencies and use some form of continuous wave transmissions; they are vulnerable to "spoofing" and, to a lesser degree, to jamming.

26. The effectiveness of a jamming signal will vary according to the type of service against which it is operating. The over-all problem involves a complex combination of types of communications and jamming signals. Skillful employment of a diversity of communications channels having differing vulnerabilities to each type of jamming can increase the amount of penetration attained, but no conventional system is invulnerable. Nevertheless, there is one type of communications of limited utility which is relatively difficult to jam; namely, the "Squirt" system whereby short messages are transmitted at very high speed on pre-arranged frequencies. The short time the signal is on the air makes it difficult to locate it and set the jammers.

III. POTENTIAL FOR INCREASING PRESENT CAPABILITIES

A. Capability for Diversion of Existing Facilities

27. The technical problem of diverting equipment and personnel

from other services to jamming, at least in the high frequency bands, is probably not difficult because (a) the basic techniques are well worked out in the existing system, and (b) there is no apparent lack of facilities available for diversion. Diversion of broadcast transmitters, regularly done during periods of maximum jamming effort, would imply that the control system presently used for jamming has connections already established not only with stations which are set up exclusively for jamming, but also with other radio communications centers. Many of the estimated 900 jammers now employed may be located at such communications centers -- there is definite evidence of this in several cases.

28. Diversion of high powered VLF and LF equipment is not as easy as the diversion of HF equipment because of technical and operational problems such as greater difficulty in making frequency changes. This diversion nevertheless is within present Bloc capabilities.

B. Potential for Increased Facilities

29. The scientific and developmental potential of the Bloc in electronics is large and could support greater jamming activity. There are indications of current laboratory developments in the jamming field. The Bloc has developed and constructed a substantial number of high-power transmitters, and has done considerable research

in this field. High-powered (20 to 500 kw.) MF and HF transmitters have been developed in East Germany, Hungary, and Czechoslovakia for broadcast and other uses. The development of a number of high-power tubes by the USSR, Hungary and Germany will also contribute to the Soviet potential for the design of high power jamming transmitters. Little is known about specific developments which would contribute to Bloc potential in VLF communications during the next two years.

30. Other factors which may indirectly contribute to Bloc jamming capacity are the normal expansion of wire line and multi-channel carrier telephone facilities, as well as the expanding use of decimeter and microwave links to supplement these and existing point-to-point radio facilities. A considerable effort is being made to develop and produce large numbers of these items for civil and military use. This could release existing radio facilities for other purposes such as jamming of long range communication circuits.

IV. BLOC VULNERABILITY TO JAMMING

31. Both microwave and wire communication facilities are practically immune to jamming. The Bloc has extensive wire line and probably some microwave facilities in the European area. In Asia, coverage by these alternate means is nearly non-existent. Expansion of alternate means probably will continue, further reducing the vulnerability of Bloc communications to radio jamming.

32. The Bloc can greatly minimize the effect of its jamming on its own communication circuits by judicious selection of transmitter locations, by use of suitable directional antennas, by use of alternate means of communication, and by advance planning. It is unlikely that interference could be avoided entirely. Due to the heavy use of the 3500-6000 kc. band by Bloc services (see attached chart), jamming in this frequency range would undoubtedly cause some trouble to their own services.

33. The Bloc fosters, controls, and trains a large number of amateur radio operators. Many of them have developed a high degree of skill in the reception of voice and telegraphy due to the heavy interference which exists on the amateur bands. This amateur skill may contribute to Bloc capability to mitigate its own and western jamming of voice and radio telegraph circuits.

34. The basic technical considerations in jamming Bloc communications are: (a) propagation conditions, (b) performance characteristics of equipment, and (c) ability to operate jammers in strategic locations. In cases where jammers could be positioned near one end of a Bloc circuit on the great circle extension of the circuit, the receiver at the other end would be highly susceptible to jamming. Receiver antenna directivity would offer no protection in such cases because of the similar directions of desired and jamming signals. In other cases, the conditions for jamming would vary greatly with

each circuit considered and the times of operation.

V. EFFECT OF GENERAL WAR ON THE FOREGOING CONSIDERATIONS

35. The technical capabilities existing during the cold war would obtain in general war conditions. It is believed that general war would be launched with jamming of long range communications circuits as part of the initial surprise, and that there would be little or no communications jamming in advance. This would include VLF communications to submarines. In addition, spoofing and jamming of navigation aids probably would be common.

36. Although the Bloc might not find it necessary to do so, confiscation of some or all broadcast receivers would release the broadcast system for jamming military targets. In that event it would be necessary to place major reliance for mass communications to the Bloc public upon the extensive wire diffusion network. Restrictions on Bloc non-essential communications traffic would release additional transmitters for jamming purposes. However, the probable change in the total volume of essential Bloc traffic under general war conditions cannot be estimated.

37. Depending on the cold war political and military situation, there may be a change in the availability to the West of sites at strategic locations for retaliatory jamming. In the event of general war, direct military action might destroy significant quantities of the jamming transmitters.

D

VI. INDICATIONS OF PRECLUSIVE USE POLICY

38. The Bloc has registered a large number of frequency assignments with the International Telecommunications Union. It has been generally held that the number exceeds its requirements. If so, it could be for the purpose of providing a stockpile of frequencies either with or without a precise plan for arbitrarily controlling the spectrum to preclude use by other nations. There is some evidence that the Bloc has made moderate use of frequencies to demonstrate those frequencies are required. However, this tactic has been employed by practically every nation and would appear to have no unusual significance.

Put on Pg. 6 as D. under Roman I.

SEE 8 APRIL DRAFT FOR FOLLOWING ATTACHMENTS:

I — Soviet and Satellite transmitting facilities.

II — Map showing US Government and commercial radio circuits, and USSR major radio communication centers.